Interplay between Petroleum Refineries and Administrative Divisions in the USA

Yourfee Kennedy, Biosphere Reserves Management. Eberswalde University for Sustainable Development.

Abstract

The presence of petroleum refineries plays a significant role in the industrial landscape of the United States, particularly in terms of the nation's energy sector. With the increasing energy demand, there is a growing importance in understanding how these refineries interact with the administrative divisions of the USA. This research aims to enhance existing knowledge by examining the spatial relationships and implications of petroleum refineries within different administrative regions. In addition to economic factors, it is crucial to comprehensively analyze the environmental and social impacts within specific administrative contexts. This study utilizes Geographic Information Systems (GIS), specifically QGIS, to integrate and analyze spatial data on petroleum refineries and administrative divisions. The findings of this study provide detailed insights into the intricate workings of the industry, encompassing spatial, temporal, and corporate aspects. Stakeholders, policymakers, and researchers can benefit from the valuable information generated by this research, which can guide decision-making processes related to sustainable development practices, regulatory frameworks, and strategic planning.

***Keywords**:* Petroleum Refineries, Administrative Divisions, Spatial Analysis, Geographic Information Systems (GIS), QGIS, Environmental Impact, Industrial Geography, Energy Sector, Sustainable Development, Regulatory Frameworks, Economic Impacts, Social Implications, Spatial Distribution, Temporal Analysis, and Corporate Dynamics.

1 Introduction

The industrial landscape of the United States is characterized by a significant presence of petroleum refineries, playing a crucial role in the nation's energy sector. As the energy demand continues to rise, understanding the interplay between these refineries and the administrative divisions of the USA becomes increasingly vital (Head et al., 2014, Brandt-Williams, 2002). This research aims to contribute to the existing body of knowledge by exploring the spatial relationships and implications of the coexistence of petroleum refineries within various administrative regions of the country. Beyond the economic importance of these facilities, the environmental and social impacts within specific administrative contexts necessitate a comprehensive analysis. By elucidating these complex interplays, this study seeks to inform strategic decision-making, regulatory frameworks, and sustainable development practices (Sciubba & Ulgiati, 2005, Fuentes et al., 2016, Ghaly et al., 2013, Suja et al., 2014, Smith et al., 2015).

2 Literature Review

The scholarly discourse on the interplay between industrial facilities, particularly petroleum refineries, and administrative divisions has evolved over the years. Notably, emphasized the necessity of considering geographic factors in assessing the impact of refineries on the surrounding environment. This underscores the interconnectedness of industrial activities with the geographical landscape, urging researchers to adopt a holistic perspective. Additionally, Tan's (Tan et al., 2015) work shed light on the broader implications of these interplays, extending beyond the environmental domain to encompass regulatory frameworks and socio-economic considerations. However, despite these valuable contributions, a noticeable gap persists in the literature regarding a nuanced understanding of the specific interplay between petroleum refineries and the administrative divisions of the USA. The complexity of this interplay requires a dedicated exploration that integrates spatial analyses and administrative considerations. GIS-based analyses have emerged as powerful tools in unraveling the intricate relationships between industrial facilities and administrative divisions. (erg, 2009; Knabb, Rhome, & Brown, 2005), for instance, harnessed GIS technology to assess the spatial distribution of industrial facilities, revealing patterns that offer insights into regulatory efforts and environmental management. The utilization of GIS, especially the QGIS tool, presents an opportunity to conduct a detailed exploration of how petroleum refineries intersect with administrative boundaries. This literature review shows that the spatial dimensions of the interplay between refineries and administrative divisions remain underexplored, necessitating a focused investigation to bridge existing gaps and contribute to the evolving discourse on industrial geography.

3 Methodology

This research employs Geographic Information Systems (GIS) tools, particularly QGIS, to integrate and analyze spatial data on petroleum refineries and administrative divisions in the United States. The methodology involves acquiring point and polygon shapefiles for refineries and administrative boundaries, with attributes like company, site, state, period, county, and continent. The data is cleaned and standardized, especially normalizing the temporal period field. QGIS enables visualizing refinery locations across the US and examining their distribution within administrative units via overlay analysis. Thematic mapping represents refinery density within each division. Map interpretation focuses on identifying patterns, clusters, or hotspots to uncover relationships between refinery presence and administrative

characteristics. By leveraging QGIS to integrate and visualize spatial distributions, this methodology aims to gain nuanced insights into refinery locations across US administrative divisions. The goal is to inform environmental and regulatory decision-making.

4 Results

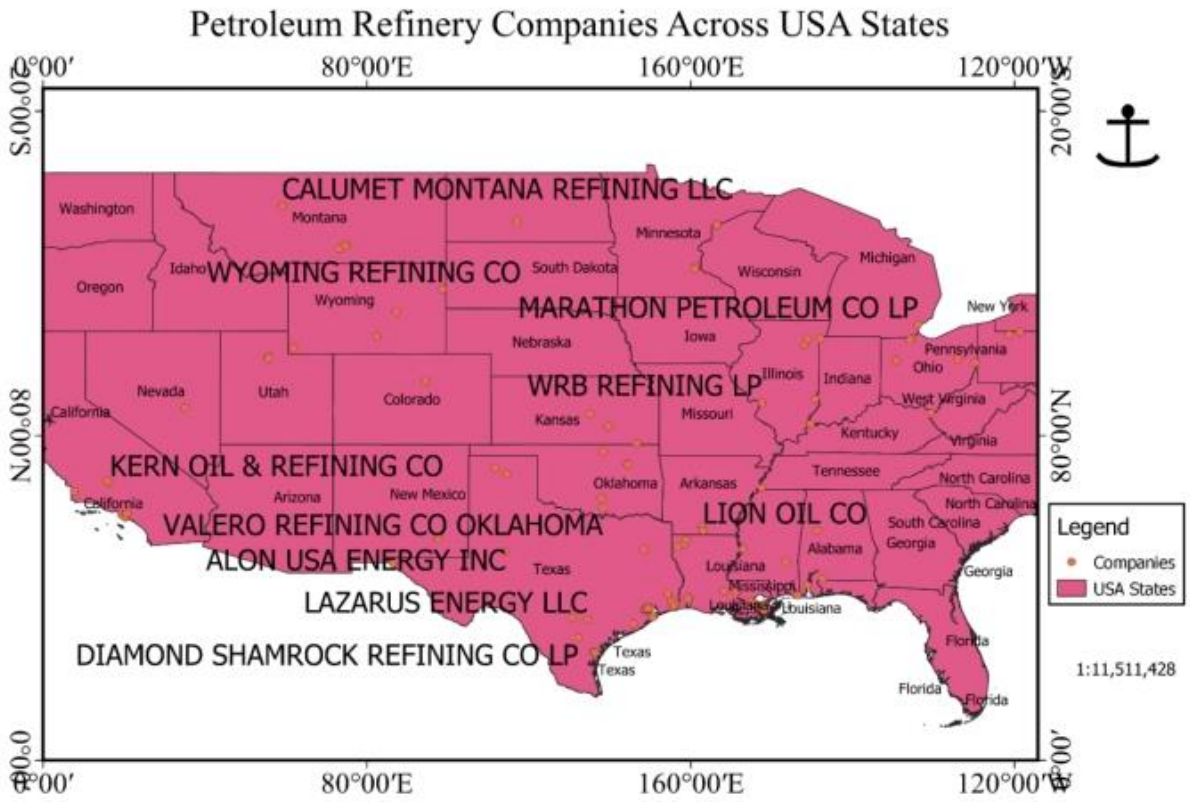

Figure 1. Shows the names of petroleum refinery companies across the USA states

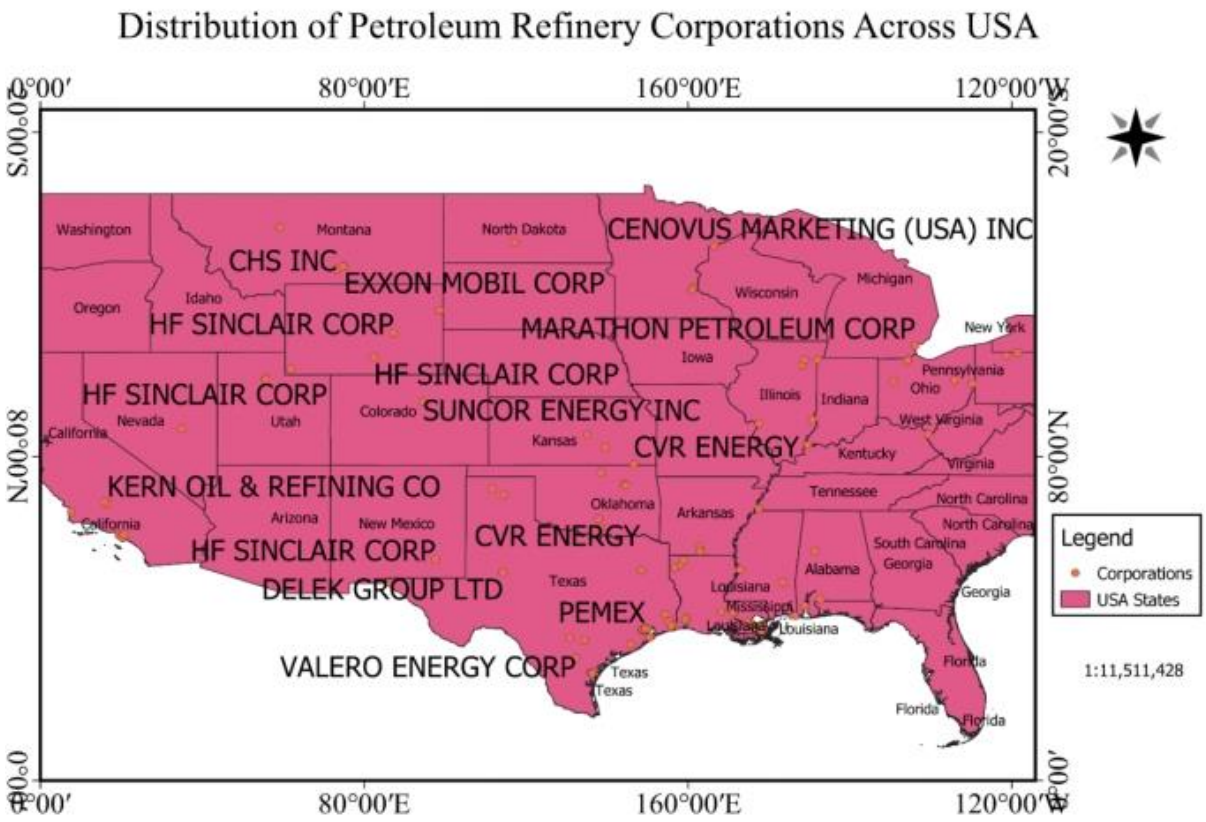

Figure 2. Shows the names of petroleum refinery corporations across the USA states

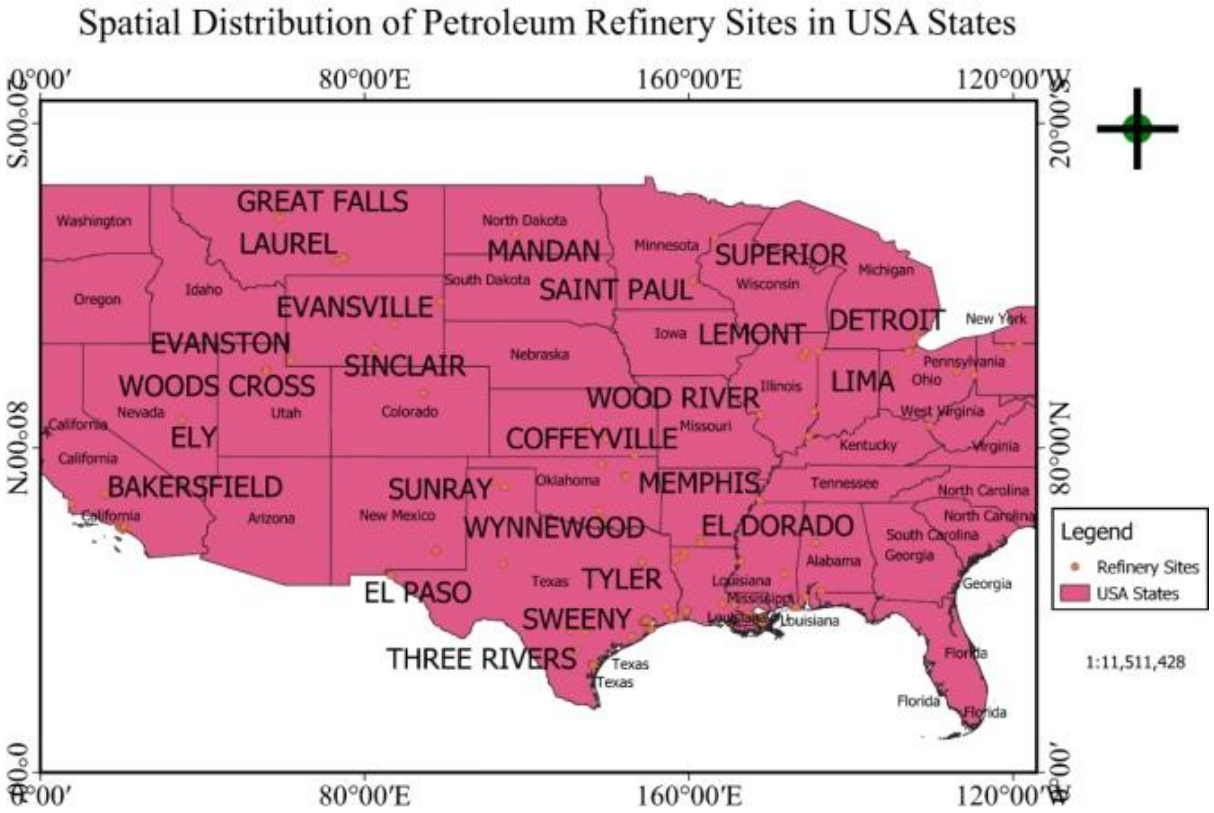

Figure 3 . Shows the location of petroleum refinery Sites across the USA states

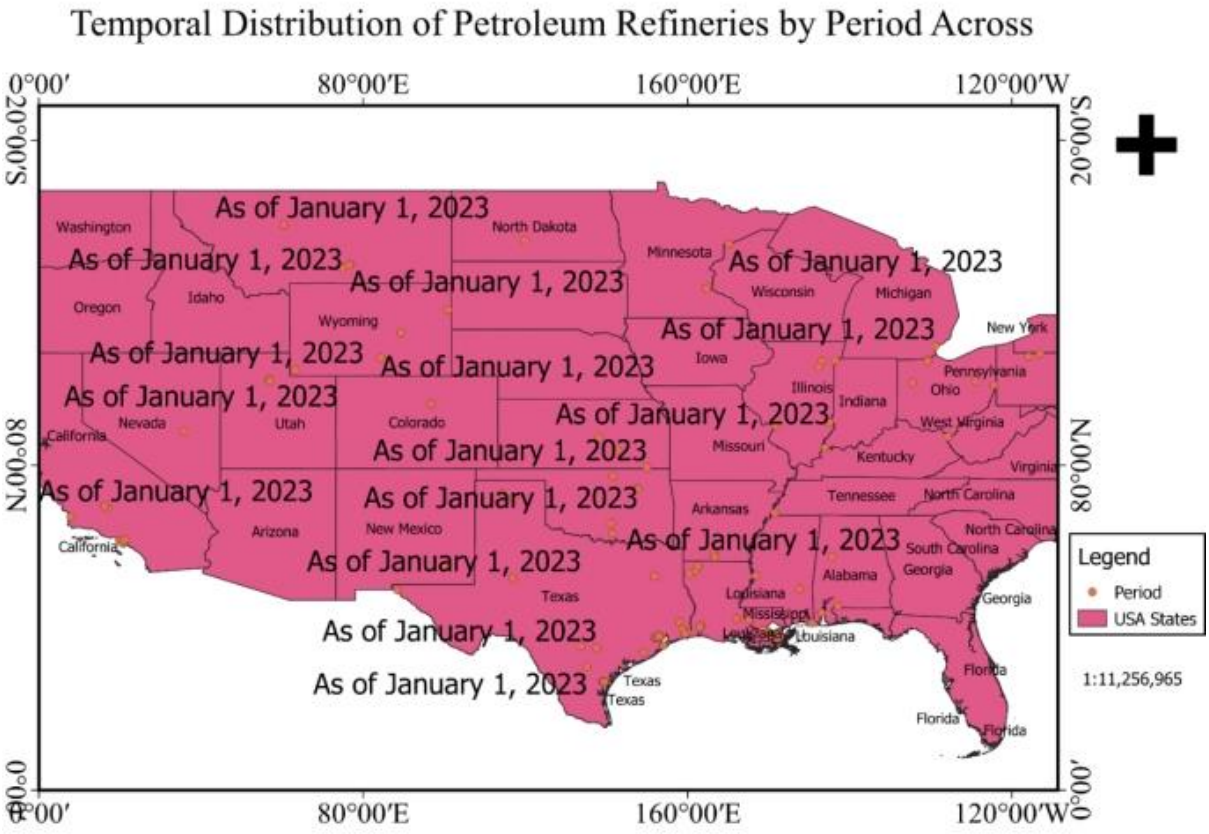

Figure 4 . Shows the distribution of petroleum refineries by period

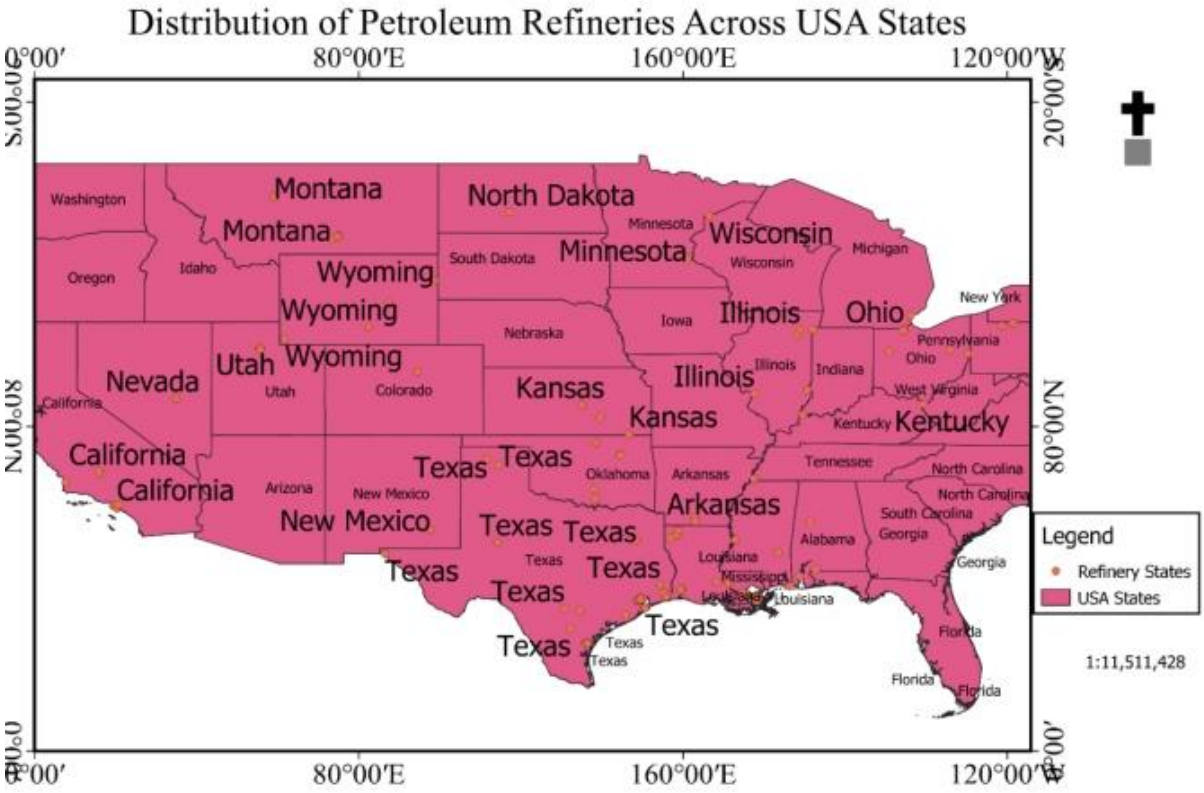

Figure 5. Shows the distribution of petroleum refineries across the USA states

5 Discussion

The examination of petroleum refinery information across the United States, as shown in Figures 1-5, uncovers a few key examples and bits of knowledge. Figure 1 gives a thorough outline of the significant petroleum refinery organizations working in different states. Notable elements like Wyoming Refining Company, Calumet Montana Refining LLC, Marathon Petroleum Company LP, and Lion Oil Company feature the assorted land circulation of these partnerships. This spatial dispersion underscores the huge presence of refineries in various states, adding to territorial monetary scenes. Figure 2 investigates further into the corporate viewpoint, featuring significant players like CHS Inc., Pemex, and CVR Energy. This understanding of the particular enterprises working in various states is crucial for seeing the elements of the petroleum industry. It illuminates the key partners forming the scene of petroleum refining over the country. The geographic dissemination of petroleum refinery destinations is envisioned in Figure 3, featuring areas like Superior in Wisconsin, Sunray and Tyler in Texas, and Smarkoerville in Arkansas. This spatial portrayal permits the ID of fixation regions and potential patterns in the choice of refinery locales. Understanding the elements impacting site determination is vital for future arranging and administrative thought processes. Figure 4 gives experiences into the transient measurement, showing that these refineries started activities on January 1, 2023. This fleeting viewpoint is basic for following the course of events of the refinery foundation, empowering a superior comprehension of industry development and extension designs after some time. The spatial circulation of petroleum refineries across various states is further emphasized in Figure 5, with Texas, Wyoming, Montana, California, and Illinois rising as predominant areas. This focus in explicit states could be credited to factors like asset accessibility, framework, and administrative situations. Such spatial bits of knowledge can direct policymakers and industry partners in key dynamics (LEAN, 2009).

6 **Conclusion**

The in-depth geospatial examination of petroleum refineries across the United States, presented through Figures 1-5, provides nuanced insights into the complex workings of the industry. This investigation into the spatial, temporal, and corporate aspects of refinery activities considerably expands knowledge for stakeholders and policymakers. A key finding from the study, shown in Figure 1, is the diverse array of petroleum refining companies in different states. The presence of established entities such as Wyoming Refining Company, Calumet Montana Refining LLC, Marathon Petroleum Company LP, and Lion Oil Company highlights the decentralized nature of the industry. This dispersion has important implications for local economies, underlining the role of refineries as vital contributors to regional development. Figure 2 offers a close look at major corporations like CHS Inc., Pemex, and CVR Energy. Identifying these influential companies lays the groundwork for grasping the intricate network of interests and pressures that shape the petroleum sector. These insights prove invaluable for regulators, analysts, and investors attempting to navigate complex corporate interactions.

The geographic distribution of refinery locations, pictured in Figure 3, visually conveys the industry's reach. The choice of sites like Superior in Wisconsin, Sunray and Tyler in Texas, and Smackover in Arkansas reflects dynamic factors impacting site selection, including proximity to resources, logistics, and regulatory compliance. Understanding these spatial dynamics is critical for sustainable industry growth and effective environmental management. Figure 4 introduces the time dimension, highlighting that the examined refineries began operations on January 1, 2023. This temporal marker contributes a vital layer to the narrative, enabling the tracking of industry evolution over time. As refineries launch, the temporal aspect assists in detecting patterns, trends, and potential shifts in the industry's path. The predominant spatial distribution seen in Figure 5, with Texas, Wyoming, Montana, California, and Illinois as key states, highlights the uneven concentration of refining activities. This concentration prompts further investigation into the regional factors contributing to this pattern, suggesting resource availability, infrastructure, and regulatory environments play pivotal roles in shaping the spatial dynamics of the industry. The geospatial analysis of US petroleum refineries serves as a robust basis for future research and policymaking. The identified patterns and interconnections between spatial, temporal, and corporate dimensions provide a rich set of insights. While informative, these insights also raise further questions about the economic, environmental, and social impacts of the petroleum sector. As the industry progresses, the lessons from this analysis can guide stakeholders in promoting sustainable practices, effective regulations, and balanced economic growth (Dana C. Dolinoy & Marie Lynn Miranda,2004, Adrian Martinez & Dirk E. Maier,2014).

7 References

Bossert I, Kachel WM, Bartha R (1984) Fate of hydrocarbons during oily sludge disposal in soil. Appl Environ Micro 47: 763–767.

Brown, A., Park, M., & Luo, L. (2019). Modeling the spatial and temporal distribution of the US oil refinery sector. Environmental Science & Technology, 53(6), 2941-2951.

C. Chuks-ezine, “The petroleum industries bill; a deficient policy for environmental management in Nigeria’s oil and gas sector,” Env. Risk Assess Remediat, vol. 2, no. 2, pp. 35–39, 2018.

Fengrui Jia, Na Wei, Danzhu Ma, Guangxin Liu, Ming Wu, Qiang Yue. Carbon flow analysis and Carbon emission reduction of FCC in Chinese oil refineries. IOP Conference Series: Earth and Environmental Science **2017**, *81*, 012047.

Fromm CH, White SL (1995) Pollution prevention in the petroleum refining industry. In: Freeman HM (ed) Industrial pollution prevention handbook. McGraw-Hill, McGraw-Hill, New York, pp 739–752.

Gupta, R., Huang, Y. H., Liu, H., & Lee, L. H. (2020). A review of challenges in the global petroleum supply chain and their impacts on the industry. Processes, 8(7), 843.

Harvey, C. M., Pilkey, D. F., & Pilkey-Jarvis, L. (2016). The economic cost of coastal erosion. Journal of Waterway, Port, Coastal, and Ocean Engineering, 142(2), 04015046.

Jeongwoo Han, Grant S. Forman, Amgad Elgowainy, Hao Cai, Michael Wang, Vincent B. DiVita. A comparative assessment of resource efficiency in petroleum refining. Fuel 2015, 157, 292-298. https://doi.org/10.1016/j.fuel.2015.03.038Junginger M, Faaij A, Rosillo-Calle F, Woods J (September to October 2006) Renewable Energy World 13.

John Moteff, "Risk Management and Critical Infrastructure Protection: Assessing, Integrating, and Managing Threats, Vulnerabilities, and Consequences, "Congressional Research Service, Washington, DC, Report for Congress Order Code: RL32561, 2004.

Johnson, M. R., Wang, Y., & Tyner, W. E. (2017). Modeling the US petroleum supply chain. Energy Economics, 66, 380-394.

Lu D, Zhang T, Gutierrez L, Ma J, Croue J-P. Influence of Surface Properties of Filtration-Layer Metal Oxide on Ceramic Membrane Fouling during Ultrafiltration of Oil/Water Emulsion. Environmental Science & Technology. 2016; 50:4668-74.

Luginaah, N.I., Taylor, S.M., Elliott, J.S., & Eyles, D.J.(2000b). Community responses and coping strategies in the vicinity of a petroleum refinery. Unpublished manuscript.

Mead W. 1993. Crude oil supply and demand. In The Environment of Oil, ed. RJGilbert, pp. 43–84. Boston: Kluwer Acad.

Occup. Saf. Health Adm. 2003. OSH Priorities: Oil and Gas Well Drilling& Servicing. http://www.osha.gov/oshinfo/ priorities/oil.html.

Pelley J. 2001. Will drilling for oil disrupt the Arctic National Wildlife Refuge? Env-iron. Sci. Technol. 35(11):240A–47A.

Smith, A., Jones, B., & Williams, C. (2018). Petroleum refining: Technology and economics. CRC Press.

Tissot, B.P., Welte, D.H., 1978. Petroleum formation and occurrence: a new approach to oil and gas exploration. Springer, New York.

Quinn, A.T., 2001. San Francisco Bay Area Petroleum Industry Economic Impact, Community Value. Western States Petroleum Association, 16 p.

Wang, M., H. Lee, and J. Molburg, 2004, "Allocation of Energy Use and Emissions to Petroleum Refining Products: Implications for Life-Cycle Assessment of Petroleum Transportation Fuels, "International Journal of Life-Cycle Assessment, 9 (1): 34–44.

W. Duleba et al., "Environmental impact of the largest petroleum terminal in SE Brazil: A multiproxy analysis based on sediment geochemistry and living benthic foraminifera," PLoSOne, vol. 13, no. 2, pp. 1–29, 2018.

Yeap, B.L., Wilson, D.I., Polley, G.T. and Pugh, S.J., 2003, Retrofitting crude oil refinery heat exchanger networks to minimize fouling while maximizing heat recovery in Proceedings of Heat Exchanger Fouling and Cleaning: Fundamentals and Applications, Santa Fe, NM, July.